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Technical Paper 1 For Revised ed see next paper.

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DEPARTMENT OF THE INTERIOR
U.S. BUREAU OF MINES
JOSEPH A. HOLMES, DIRECTOR

THE SAMPLING OF COAL IN THE MINE

BY

JOSEPH A. HOLMES

(RECAP)
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WASHINGTON
GOVERNMENT PRINTING OFFICE
1911

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FIGURE 1. Sampling outfit 5

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THE SAMPLING OF COAL IN THE MINE.

By JOSEPH A. HOLMES.

GENERAL STATEMENT.

In connection with the fuel investigations that were begun by the United States Geological Survey about six years ago, the question of whether or not to publish all known authentic analyses of American coals was considered. It was decided not to publish them, because, with respect to by far the greater number of analyses, either no reliable record of the samples was available or else the purpose and method of collecting the samples had been such as to render the analyses, however carefully made, of little or no value to the public.

In planning the fuel investigations of the Geological Survey, the committee having the matter in charge, Messrs. E. W. Parker, M. R. Campbell, and the writer, decided upon a plan of sampling coal in the mine that, it was believed, would satisfy the following requirements: (1) Each group of mine samples submitted for analysis to represent fairly the commercial shipments of coal from the mine in which they are collected; (2) the complete history of each sample to be known and recorded; and (3) each sample to be analyzed promptly and by the best standard method.

This plan of collecting mine samples was initiated during 1904, largely under the personal supervision of Mr. Campbell. With various modifications it has been continued from that time up to the present by those geologists of the survey, who, under Mr. Campbell's direction, have been examining the coal deposits on or near the public lands, and by those engineers of the Survey and the Bureau of Mines, who, under the direction of the writer, have continued the work of analyzing and testing the coal from the various fields in the United States.

The following statement of the system of mine sampling in use by the Geological Survey and the Bureau of Mines has been revised by Messrs. M. R. Campbell and David White, of the Geological Survey, and Mr. G. S. Rice, of the Bureau of Mines.

NEED OF CARE IN SAMPLING.

In dealing with coals no less than in dealing with ores, the taking of the sample requires fully as much care as does the making of the analysis or assay. And the difficulties in the way of obtaining, at reasonable cost, a sample of coal that fairly represents the commercial product as found in the mine or, more especially, as loaded

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in cars or in ships, have seriously retarded the movement for the sale or purchase of coal on a rigid specification basis.

The purpose of this paper is to describe briefly the method now followed by the Bureau of Mines and United States Geological Survey in an endeavor to take mine samples that fairly represent the beds of coal that are examined and that show, for the places sampled, the commercial possibilities of these beds. It is of the utmost importance that the sampling be done in a systematic manner, according to a prearranged plan, and that the same procedure always be followed where circumstances permit. Wherever it is possible, unless special samples are desired for a particular purpose, only clean, fresh coal should be sampled, and all dried, weathered, or long-exposed coal should be avoided. When weathered coal, either in the outcrop or in pillars, or other special samples are collected, the particular characteristics of each sample should be clearly described.

COLLECTING OUTFIT OR SAMPLING KIT.

The coal-mine sampling outfit (fig. 1) used by the Bureau of Mines comprises the following articles: Carrying bag, sampling cloth (heavy oilcloth), portable mortar and pestle, spring balance, screen, sampling scoop, brush, measuring tape, sample cans, adhesive tape, pick, and shovel.

Carrying bag.—The bag used for carrying the sampling outfit and the collected samples is of leather, has a shoulder strap, and measures 13 by 12 by 3 inches.

Sampling cloth.—For collecting the cuttings chipped from the face of the coal a stout sheet or blanket of waterproof material is used. The heavy enamel cloth known as buggy cloth gives good service. The cloth should measure not less than 6 by 7 feet. The enameled side of this cloth should be laid next to the ground to keep out moisture and to prevent fragments of the enamel from getting into the coal sample.

Portable mortar.—A piece of ¾-inch board, 10 inches square, covered on the upper side with heavy galvanized sheet iron, forms the bottom of the portable mortar. The collapsible sides are of stout duck, and are fastened at the top to a strap-iron band that is held up by collapsible strap-iron posts fastened by set screws. The sides are 5 inches high, making the contents of the mortar about 500 cubic inches.

Pestle.—The pestle for crushing samples consists of a steel head, 1 inch thick and 3 to 4 inches square, with a screw socket to receive a wood handle about 14 inches long.

Spring balance.—A good spring balance of 50-pounds capacity, graduated preferably to one-half pound, is used for weighing the samples.

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Screen.—The screen is of galvanized-iron wire and has a ½-inch, or preferably ⅜-inch, mesh. It is about 10 inches square and has a wood frame.

Sampling scoop.—The scoop recommended is made of heavy galvanized sheet iron, with flat bottom and vertical sides, and is 8 inches long, 2 inches deep, and 1¼ inches wide. If such a scoop is not available, a bricklayer's trowel or even a wooden shingle will answer the purpose.

Brush.—A stiff brush or whisk broom is useful for brushing off loose pieces of coal, stone, or dirt from the face or roof at the place where the sample is to be taken and for removing the rejected quarterings of coal from the sampling blanket. If such a brush is not available, a piece of cloth or an old coat may be used as a substitute.

Measuring tape.—For measuring coal-bed sections a 20-foot waterproof tape graduated to one-fourth inch is used. A steel tape graduated to one-sixteenth inch, though more accurate, is less convenient, since the figures are more difficult to read by the poor light available in mines.

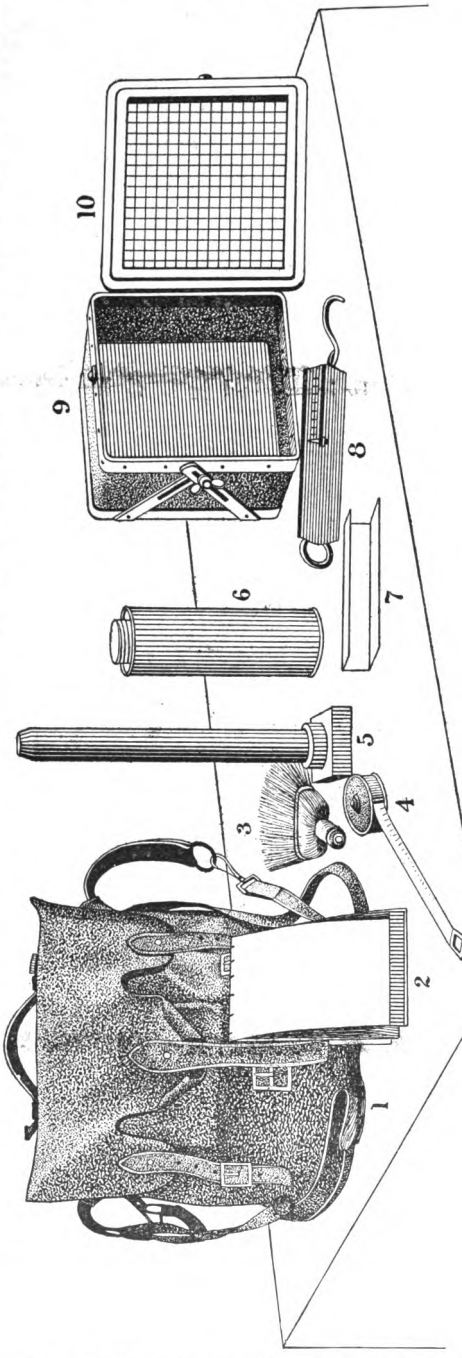

FIGURE 1.—Sampling outfit: 1, carrying bag; 2, notebook; 3, brush; 4, measuring tape; 5, pestle; 6, sample can; 7, sampling scoop; 8, spring balance; 9, portable mortar; 10, screen.

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Sample can.—The vessel ordinarily used by the Bureau of Mines and by the Geological Survey for transporting coal samples is a 9 by 3-inch round can of No. 27 galvanized iron. The can filled with coal should not weigh more than 4 pounds, which is the limit of weight for ordinary transmission by mail. The edges of the can are crimped and carefully soldered to make them tight and strong; the screw top (2 inches in diameter) has a gasket or washer of rubber or other flexible material to exclude the air. As a further protection, the outside of the cap, when in place and screwed down tightly, is wrapped carefully with several layers of adhesive tape so that the first layer of this tape completely covers the joint between the lower edge of the cap and the neck of the can. It is not advisable to use solder, paraffine, or sealing wax of any kind. Before being filled each can should be carefully inspected as to tightness and freedom from rust.

Adhesive tape.—For sealing the connection of the cap and sample can, bicycle or electrician's adhesive tape of the best quality is used.

Pick and shovel.—Nothing is better than a miner's pick for cutting samples. A miner's shovel should be taken along for cleaning up the floor, etc. Pick and shovel are not regularly included in the kit, as they can be had at any working mine.

The field men of the Geological Survey, because they often work long distances from a base of supplies and travel by horseback, usually carry a simpler outfit than that described above, consisting of a waterproof blanket, a measuring tape, adhesive tape, a screen, a geologist's pick, an improvised shovel, and the necessary number of sample cans. Instead of using a portable mortar and pestle, a man thus equipped must pulverize the coal with his pick, on a board or other hard surface, and instead of a scoop he must use a trowel or shingle. He does not weigh the coal; and instead of using a brush or broom, he removes loose coal, etc., from the face and roof, and cleans the quarterings off the sampling blanket with his coat or a piece of cloth. He will ordinarily use a miner's pick, if found in the mine, instead of his geologist's pick for cutting down the coal.

PRELIMINARY DETAILS.

PROCURING A MAP OF THE MINE.

A map of the mine to be examined should be obtained from the company's office for use in the preliminary examination of the mine and for indicating the exact location from which each sample is to be collected. If the tonnage output of the mine is known, the places for collecting samples should be determined tentatively before entering the mine, the locations to be changed as the work progresses, if such changes prove to be desirable.

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EXAMINATION OF THE MINE.

To determine exactly where and how it may be best to collect samples that will satisfactorily represent the character of the coal bed and to ascertain what portion of the bed is excluded in mining and loading, the collector with map in hand should make a preliminary examination of the mine in company with a guide who is familiar with the workings. This examination will enable the collector to select the exact places for collecting samples and to indicate them on his map.

NUMBER OF SAMPLES TO BE COLLECTED.

From any mine shipping coal the number of samples should not be less than four for a daily production of 200 tons or less, and the number should increase at the rate of one sample for each additional 200 tons of coal mined per day. The number should be greater from mines in which the quality of the coal varies greatly. Where only a part of a bed is being mined and the remainder (1 foot or more in thickness) is being left under ground, separate samples should be collected at each sampling place of both the worked and the unworked parts or benches of the bed. In sampling coal beds exposed in ordinary prospect openings, where the coal is usually more or less weathered, one sample from each opening is considered sufficient, unless the openings are far apart; in that case occasional second or check samples are highly desirable.

SELECTING PLACES FOR SAMPLING.

Having decided upon the probable number of samples to be collected and approximately where they are to be taken, the collector during his preliminary examination of the mine should decide upon the exact location from which each sample is to be collected, so that it will represent the coal mined in that part of the workings. Furthermore, certain of the samples should be taken from places in the remoter parts of the mine, so that the samples will indicate the character of the coal available for future as well as for present shipments. Exceptional features, such as faults, etc., should be avoided unless special studies of the coal at these places are thought desirable. Where it is possible, wet places should be avoided, as samples from such places may not represent the coal as shipped. Where wet coal must be collected, the surplus moisture should be drained off the sampling cloth before mixing the sample.

METHOD OF SAMPLING.

CLEANING OFF THE FACE OF THE COAL.

At each selected point, before a sample is cut, the face of the bed should be cleared of burned powder, dirt, or loose coal from roof to floor for a width of about 5 feet. This is done to prevent any loose

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fragments or foreign matter from falling off the face of the coal onto the sampling cloth. Insecure pieces of the roof should also be taken down in advance for the same reason. In the middle of this cleared area on the face, the coal should be cut away with the pick from the roof to the floor for a width of 1 foot and a depth of at least 1 inch, with a view to removing any discolored, altered, or otherwise inferior coal that might be near the surface, and also to square up this portion of the face in preparation for the sampling cut.

WHAT TO INCLUDE IN THE SAMPLE.

There should go into the sample as it is cut from the face all the material that ordinarily goes into the daily shipments of coal. There should be omitted from the sample only such material as is ordinarily discarded by the miner. Usually partings more than three-eighths of an inch thick and lenses or concretions of "sulphur" or other impurities more than 2 inches in maximum diameter and one-half of an inch thick are excluded, if in the judgment of the sampler they are being excluded by the miner from the coal as loaded out of the mine or as shipped. If such impurities, or other impurities, are not generally excluded by the miner, they should be included in the sample. If pillars are being "pulled," careful note should be made not only of partings, but of materials from the roof that are not rejected by the miner. Where the impurity to be rejected, like bone or slaty coal, does not show conspicuously, it is advisable to outline the impurity with chalk before cutting the sample, to prevent its being overlooked when the sample is being cut.

Imitating the miner in excluding impurities is the best method, but this requires care and judgment, especially where the partings are soft and crumble. No two miners can be relied on to discard the same partings to the same extent, even at mines where the most rigid regulations for cleaning the coal are in force. Since it is desired to obtain samples that represent as nearly as possible the coal that is produced commercially from the mine under examination, this method should be followed as closely and as uniformly as possible. The carrying out of this method demands the exercise of judgment and experience on the part of the sampler, and he must familiarize himself with the impurities in the coal bed and their relation to the coal as shipped.

Where the coal is washed before being shipped, duplicate samples of the washed coal and the tailings should be collected and mailed to the Bureau of Mines with the mine samples.

COLLECTING AND PREPARING THE SAMPLE.

The collector should smooth and clean the floor and spread the sampling cloth on it close to the face of the coal. Then he should make a perpendicular cut 2 inches deep and 6 inches wide (or 3 inches deep

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and 4 inches wide in the softer coals) from the roof to the floor down the middle of the foot-wide cut previously made in the coal face. He should be careful to make this cut uniform in width and depth and should chip off enough coal to make a sample weighing at least 6 pounds for each foot of the thickness of the bed; so that the sample collected on the blanket from a 6-foot bed will weigh not less than 36 pounds. Inexperienced collectors should weigh their samples (by spring balance or otherwise) as a check on the accuracy of their work.

As soon as the cutting of the sample has been completed, if the full outfit previously described is available, the finer portions of the sample should be put through the ½-inch or ⅜-inch screen and the lumps should be broken in the mortar until all the sample passes through the screen. The sample should then be thoroughly mixed by two men grasping the opposite corners of the blanket and rolling it diagonally by raising one corner at a time. When the larger pieces of coal are evenly distributed throughout the mass, the sheet should be laid on the floor and the top of the pile flattened with a clean dry shovel, trowel, or board. The sample is then quartered and two opposite quarters are discarded and brushed off. The remainder is mixed as before, and if the sample is still too bulky for convenient handling it is again quartered down. The material finally remaining is spread into a circular mass about 2 inches deep on the sheet, and the sampling scoop is used to fill the sample can compactly with portions from opposite quarters. The entire operation described above from the cutting of the sample to the sealing of the can should be done in the mine, so as not to expose the coal to the outside atmosphere.

THE CAN SHOULD BE COMPLETELY FILLED.

It is important that the coal be well packed in the can, so as to occupy as much of the space as possible, since in this way the air is more nearly excluded. This is best accomplished by crushing fine a considerable proportion of the coal and by shaking or jarring the can repeatedly and vigorously while filling it.

SEALING THE CAN.

As soon as the can has been filled and the label (described below) placed inside, the cap should be screwed on so that the top of the screw fits tightly into the rubber or other flexible material in the cap; adhesive tape should then be carefully wrapped around the lower outer edge of the cap in such a manner as to cover the joint and increase the thoroughness of the sealing.

LABELING.

Each sample can when sent out should have a number printed on it. This number is to be used by the collector as the field number

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for the sample placed in that can for analysis, and is to be recorded in his notebook and on his cards. Before the can is sealed, a label should be placed in it on the top of the coal. This label should bear the field number, the name and location of the mine, the exact location from which sample was taken, the name of the collector, and the date, and should be sealed in a small envelope to prevent obliteration of the writing. Around the outside of the can a second label should be attached, bearing the same field number, the name of the collector, the date of the collection, and the address of the Bureau of Mines at Pittsburg.

NOTES.

To facilitate the gathering and recording of data concerning the samples of coal and the mines from which they are taken, blank forms have been prepared for the use of collectors. These forms can be had upon application to either the Director of the Bureau of Mines or the Director of the Geological Survey. The forms,[a] which are of convenient size for the pocket, indicate what information is desired concerning the nature and operations of the mine, the number, depth, and character of the beds of coal, the specific location from which each sample was taken, and the exact character of the bed at the point of sampling, and make specific mention of bands of "sulphur" (pyrite, etc.), shale, or other objectionable material that should be excluded in shipment.

The record of the coal-sample section should be made in the mine from actual measurements, immediately after the collection of the sample and the sealing of the sample can.

PROMPT FORWARDING AND ANALYSIS OF SAMPLES.

The cans containing the samples should be delivered by the collector in person to the nearest post office for forwarding by the first mail to the Bureau of Mines laboratory at Pittsburg.

It is expected that each sample on its receipt at the laboratory will be placed in a dark, cool place, and that the analysis will be completed within two weeks.

SENDING NOTIFICATION CARDS.

The cards, supplied in advance to each collector, are arranged in three sections, A, B, and C. After entering certain data (his own name, the number and date of the sample, etc.) called for in the blank forms printed on each of these three section cards, the collector forwards, in sealed envelopes, for each sample, card A to the headquarters of the chief of party, and cards B and C to the Bureau of Mines chemical laboratory at Pittsburg. As soon as these cards

[a] Copies of the forms are appended to this circular.

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and the corresponding sample are received at Pittsburg, a statement of the receipt of sample is entered on cards B and C; card B is retained in the chemical laboratory files, and card C is then sent to the chief of the field party, in order to give notice of the arrival of the sample.

Special attention should be given to filling out and promptly forwarding these cards. Failure to fill out a card properly or to forward it promptly may cause indefinite delay in making the analysis of a sample.

BLANK FORMS FOR COLLECTORS.

Copies of the blank forms carried by the engineers of the Bureau of Mines for recording the information desired regarding a sample of coal and the mine from which it is taken are given herewith. These forms are printed on separate sheets that are perforated, and are intended for use with a loose-leaf binder. They make a notebook measuring about 4½ by 7½ inches. (See following pages.)

DEPARTMENT OF THE INTERIOR,

BUREAU OF MINES.

A.—*Physical features of the mine.*

Name of collector.....
Mine..... Date.....
State..... County.....
Township..... S..... T..... R.....
Mine location (distance and direction from nearest railway station).....
.....
Mine railway connections.....
Operator of mine.....
Address of operator.....
Address of mine.....
Superintendent.....
Pit boss.....
Selling agent.....
Address.....
Trade name of coal.....
Coal-bed name..... Geologic formation.....
Kind of coal.....
Average thickness of coal bed.....feet.....inches.
Dip of bed.....° Direction of dip.....
Has coal "faces"?..... Direction of.....
Faults.....; frequent?.....
Rolls or horse backs.....; frequent?.....
Does mine make methane?.....from coal, roof, or floor.....
Quantity evolved.....maximum in return.....per cent.
Entrance to mine: Drift, cross-drift, slope, shaft.....
Elevation of entrance above sea, barometric reading..... Actual.....feet.
Vertical depth to bed (below entrance).....feet.
System of mining.....

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Is mine laid out with reference to "butts" and "faces"?.....
Entry width, main.....feet; side entry.....feet; stub.....feet.
Pillar width, main.....feet; side entry.....feet; stub.....feet.
Room pillar width.....feet; barrier pillar width.....feet.
Room width.....feet; room length.....feet.
Room pillars pulled?..... Entry pillars pulled?.....
Proportion of coal taken in advance work.....
Per cent recovery excluding roof coal.....per cent including..... per cent.

B.—*Mine equipment.*

Equipment of.....mine. Date....., 191
Capacity per day.....tons. Actual average.....tons.
Number of men underground..... Above.....
Steel or wood tipple.....
Cage, type.....
Hoisting or slope engines.....
Boilers, number..... Horsepower.....
Fan, type of..... Average water gage.....inches.
How driven.....
Number of splits air.....
Miner's lamps, open or closed..... Kind.....
Oil used..... Smoky or bright.....
Lighting system on main roads..... Voltage.....
Mine water, gallons per minute..... Pump driven by.....
Coal-cutting machines, type.....
Number of..... Voltage.....D. C. or A. C.
Haulage system.....
If electric, voltage..... Number locomotives.....
Cars, weight.....pounds. Capacity.....pounds.
Rails, weight, in entries.....pounds. Rooms.....
Track gage.....inches.
Ties, kind of wood..... Size.....
Props, kind of wood..... Props per ton.....
Stoppings, material; main entries....., side entries.....
Room-mouth stoppings, if any.....

C.—*Station humidity report* (1).

Mine.....
Date....., 191 ; hour.....
Station.....
Distance from entrance or shaft.....feet.
Dry bulb.....°; wet bulb.....°; barometer.....inch.
Depression (t—t′).....°; relative humidity.....per cent.
Passage: Width.....feet; height.....feet; area.....square feet.
Velocity air per minute, reading.....feet; corrected.....feet.
Volume air per minute.....cubic feet.
Intake or return.....
At station, is floor dry or moist?.....
At station, are ribs dry or moist?.....
At station, is roof dry or moist?.....
Method of sampling air..... Sample No.....

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D.—*General humidity report* (2).

General humidity condition of.....mine.
Is the coal naturally dry or moist?.....
Are the working places dry or moist?.....
Are goaves dry or moist?.....
In entries is floor clean or dusty?.....
Is dust pure or mixed with rock dust or clay?.....
In entries, is floor dry or moist?.....
Are ribs and roof coated with dust?.....
Is the above dust dry or moist?.....
Are timbers, if any, coated with dust?.....
Method of humidifying:
(*a*) Sprinkling by cars..... How often?.....
(*b*) Sprinkling by hose..... How often?.....
(*c*) Are ribs and roof sprinkled?.....
(*d*) Water sprays..... Number.....
How located?.....
Kind or manufacture?.....
(*e*) How many hours do sprays run?.....
(*f*) Exhaust steam sprays.....
Where located?.....
Design of spray?.....
(*g*) How far does steam fog the air?.....
How much water, by any of above methods, is artificially introduced, in gallons per minute?.....; per 24 hours?.....
General humidity notes:
.....
.....
.....

E.—*Explosive report.*

Mine..... Date....., 191
Blasting methods.....
(*a*) By battery..... By fuse..... By squibs.....
(*b*) By shotfirers..... Number of.....
Time of shooting..... After miners out.....
(*c*) By miners..... Time of shooting.....
(*d*) By electricity when all men out of mine.....
Detonators, kind and strength.....
Explosives used.....
For coal.....
For brushing roof or floor.....
Amount used per day in coal..... In rock.....pounds.
Coal per keg of powder.....tons.
Explosives (exclusive of brushing) per ton (2,000 pounds) of coal.....pounds.
What is the maximum amount one miner can have in his possession under ground?.....pounds.
In what receptacle is explosive carried into mine?.....
Does miner carry explosive to face?.....
Is explosive kept in box or loose?.....
What is maximum diameter of drill hole?.....inches.

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What is maximum size of charge?.....pounds.
If powder, is it put in loose, or in paper cartridges?.....
What tamping material is used?.....
Is it dug or sent into mine?.....
What kind of tamping bar is used?.....
Is this mine subject to "windy" shots?.....
Has this mine experienced any explosions?.....

(Give dates and particulars on a blank sheet.)

F.—*Mining conditions.*

Range in thickness of coal as mined: From.....feet.....inches to.....feet.....inches. Average.....feet.....inches.
Variability of partings or other impurity in character and thickness?.....
.....
Roof (*a*) Draw slate (coming down with coal).....thickness.
(*b*) Shale, quality, color, etc.....
.....
(*c*) Roof coal..... Quality..... Thickness.....
(*d*) Sandstone or limestone.....
Is immediate roof smooth or does coal stick?.....
Does immediate roof fall in rooms?.....
Is there a cap rock or main roof above?.....
Height of cap rock, etc., above coal.....feet.
Do particles of roof get mixed with coal in loading?.....
Vertical height to nearest workable coal above.....feet.
Vertical depth to nearest workable coal below.....feet.
Floor or underclay:
Kind.....
Softness.....
Smooth or rough.....
Do particles get mixed with coal?.....
Is coal undercut in clay floor or in coal?.....
Undercut by hand or machine?.....
Are machine cuttings loaded with coal?.....

FUTURE OUTPUT AND PRODUCTION.

Approximately what unmined area is to be taken out from present opening?....acres.
What is probable lifetime of mine?.....years.
Is the tonnage to be derived from advance work or pillars?.....
In what proportions?.....
Present average daily output of mine.....tons (2,000 pounds).
Maximum day's run.....
To what extent is daily output to be increased or diminished in future?.....
.....

G.—*Preparation for market.*

Proportion of output shipped as "run of mine".....
What percentage of coal going to screens passes through?.....
.....

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Type of lump screens, bar, shaking, etc.:
Size of opening.....
(*a*) Bar, length.....feet.
Spaces, width.....inches.
(*b*) Shaking screen, area.....feet by.....feet.
Diameter of holes.....inch.
Type of small-coal screens, if any:
(*a*) Bars, length.....
Space, width.....inches.
(*b*) Shaking screens, area.....feet by.....feet.
Diameter of holes.....inch.
(*c*) Revolving screens, length.....feet.
Diameter of holes.....inch.
Diameter of mesh.....inch.
Is coal picked on belt or on car?.....
Number of pickers (or trimmers who pick).....
Are screenings washed?..... Maximum size washed.....inch.
Sizes produced by washing.....
Type of washery.....
Average daily tonnage.....tons (2,000 pounds).
Are screenings coked?..... Are they crushed?.....
Average daily tonnage coal coked.....
What storage-bin capacity?.....tons.
Appearance of lump coal on cars.....
Lumps, large or small?.....
Appearance of screenings on cars.....
Loading tracks, number of.....
Track capacity for empty railway cars.....
Track capacity for loaded railway cars.....
REMARKS:
.....
.....
.....

H.—*Coal sample section.*

Mine..... Date,....., 191...
State..... Can No.....
County..... Township.....
Name of bed of coal.....
Location of mine.....
Total (vertical) depth from surface at point of sampling.....feet.

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[In describing the beds and character of the members note any member that is rejected by the miner. Note all clay and sulphur partings, whatever their thickness. Exclude from sample all clay and sulphur partings ⅛ inch thick or over (and even those of less thickness) if they are rejected at mine or tipple.]

Section of bed at point sampled.

Description.		Feet.	Inches.
Roof (main)			
Roof (immediate)			
No.	1		
	2		
	3		
	4		
	5		
	6		
	7		
	8		
	9		
	10		
	11		
	12		
	13		
	14		
	Total		
Floor			

Is coal sample wet or dry?.....
Time exposed.....hours.....minutes.
Weight.....gross.....net.
What are the impurities and how do they occur? .....
.....
What impurities are shipped with the coal?.....
What impurities are excluded from the sample?.....
Collector.....

PUBLICATIONS ON FUEL TESTING.

The following publications, except those to which a price is affixed, can be obtained free by applying to the Director of the Bureau of Mines, Washington, D. C. The priced publications can be obtained by sending the price, in cash, to the Superintendent of Documents, Government Printing Office, Washington, D. C.

PUBLICATIONS OF THE BUREAU OF MINES.

BULLETIN 1. The volatile matter of coal, by H. C. Porter and F. K. Ovitz. 1910. 56 pp., 1 pl.

BULLETIN 2. North Dakota lignite as a fuel for power-plant boilers, by D. T. Randall and Henry Kreisinger. 1910. 42 pp., 1 pl.

BULLETIN 3. The coke industry of the United States as related to the foundry, by Richard Moldenke. 1910. 32 pp.

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BULLETIN 5. Coking and washing tests of coal at Denver, Colo., July 1, 1908, to June 30, 1909, by A. W. Belden, J. W. Groves, K. M. Way, and G. R. Delamater. 1910. 62 pp.

BULLETIN 7. Essential factors in the formation of producer gas, by J. K. Clement, L. H. Adams, and C. N. Haskins. 1911. 58 pp., 1 pl.

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BULLETIN 11. The purchase of coal by the Government under specifications, by G. S. Pope. 1910. 80 pp. Reprint of United States Geological Survey Bulletin 428.

BULLETIN 12. Apparatus and methods for the sampling and analysis of furnace gases, by J. C. W. Frazer and E. J. Hoffman. 1911. 22 pp.

TECHNICAL PAPER 2. The escape of gas from coal, by Horace C. Porter and F. K. Ovitz. 1911.

PUBLICATIONS OF THE UNITED STATES GEOLOGICAL SURVEY.

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BULLETIN 261. Preliminary report on the operations of the coal-testing plant of the United States Geological Survey at the Louisiana Purchase Exposition, in St. Louis, Mo., 1904; E. W. Parker, J. A. Holmes, M. R. Campbell, committee in charge. 1905. 172 pp. 10 cents.

PROFESSIONAL PAPER 48. Report on the operations of the coal-testing plant of the United States Geological Survey at the Louisiana Purchase Exposition, St. Louis, Mo., 1904; E. W. Parker, J. A. Holmes, M. R. Campbell, committee in charge. 1906. In three parts. 1492 pp., 13 pls. $1.50.

BULLETIN 290. Preliminary report on the operations of the fuel-testing plant of the United States Geological Survey at St. Louis, Mo., 1905, by J. A. Holmes. 1906. 240 pp. 20 cents.

BULLETIN 323. Experimental work conducted in the chemical laboratory of the United States fuel-testing plant at St. Louis, Mo., January 1, 1905, to July 31, 1906, by N. W. Lord. 1907. 49 pp. 10 cents.

BULLETIN 325. A study of four hundred steaming tests made at the fuel-testing plant, St. Louis, Mo., 1904, 1905, and 1906, by L. P. Breckenridge. 1907. 196 pp. 20 cents.

BULLETIN 332. Report of the United States fuel-testing plant at St. Louis, Mo., January 1, 1906, to June 30, 1907; J. A. Holmes, in charge. 1908. 299 pp. 25 cents.

BULLETIN 334. The burning of coal without smoke in boiler plants; a preliminary report, by D. T. Randall. 1908. 26 pp. 5 cents. (See Bull. 373.)

BULLETIN 336. Washing and coking tests of coal and cupola tests of coke, by Richard Moldenke, A. W. Belden, and G. R. Delamater. 1908. 76 pp. 10 cents.

BULLETIN 339. The purchase of coal under Government and commercial specifications on the basis of its heating value, with analyses of coal delivered under Government contracts, by D. T. Randall. 1908. 27 pp. 5 cents. (See Bull. 428.)

BULLETIN 343. Binders for coal briquets, by J. E. Mills. 1908. 56 pp.

BULLETIN 362. Mine sampling and chemical analyses of coals tested at the United States fuel-testing plant, Norfolk, Va., in 1907, by J. S. Burrows. 1908. 23 pp. 5 cents.

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BULLETIN 363. Comparative tests of run-of-mine and briquetted coal on locomotives, including torpedo-boat tests and some foreign specifications for briquetted fuel, by W. F. M. Goss. 1908. 57 pp., 4 pls.

BULLETIN 366. Tests of coal and briquets as fuel for house-heating boilers, by D. T. Randall. 1908. 44 pp., 3 pls.

BULLETIN 367. Significance of drafts in steam-boiler practice, by W. T. Ray and Henry Kreisinger. 1909. 61 pp.

BULLETIN 368. Washing and coking tests of coal at Denver, Colo., by A. W. Belden, G. R. Delamater, and J. W. Groves. 1909. 54 pp., 2 pls. 10 cents.

BULLETIN 373. The smokeless combustion of coal in boiler plants, by D. T. Randall and H. W. Weeks. 1909. 188 pp. 20 cents.

BULLETIN 378. The purchase of coal under Government specifications, by J. S. Burrows. 1909. 44 pp. 10 cents. (See Bull. 428.)

BULLETIN 382. The effect of oxygen in coal, by David White. 1909. 78 pp., 3 pls. 25 cents.

BULLETIN 385. Briquetting tests at the United States fuel-testing plant, Norfolk, Va., 1907–8, by C. L. Wright. 1909. 41 pp., 9 pls.

BULLETIN 392. Commercial deductions from comparisons of gasoline and alcohol tests on internal-combustion engines, by R. M. Strong. 1909. 38 pp.

BULLETIN 393. Incidental problems in gas-producer tests, by R. H. Fernald, C. D. Smith, J. K. Clement, and H. A. Grine. 1909. 29 pp. 5 cents.

BULLETIN 402. The utilization of fuel in locomotive practice, by W. F. M. Goss. 1909. 28 pp.

BULLETIN 403. Comparative tests of run-of-mine and briquetted coal on the torpedo boat *Biddle*, by Walter T. Ray and Henry Kreisinger. 1909. 49 pp. 10 cents.

BULLETIN 412. Tests of run-of-mine and briquetted coal in a locomotive boiler, by Walter T. Ray and Henry Kreisinger. 1909. 32 pp.

BULLETIN 428. The purchase of coal by the Government under specifications, with analyses of coal delivered for the fiscal year 1908–9, by G. S. Pope. 1910. 80 pp. 10 cents. Reprinted as Bureau of Mines Bulletin 11.

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Technical Paper 1 a. (Revised ed.)

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THE SAMPLING OF COAL IN THE MINE

BY

JOSEPH A. HOLMES

WASHINGTON
GOVERNMENT PRINTING OFFICE
1918

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Revised edition. July, 1918.
First edition issued, May, 1911.

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THE SAMPLING OF COAL IN THE MINE.

By JOSEPH A. HOLMES.

GENERAL STATEMENT.

Systematic collection and analysis of coal samples in connection with investigations relating to fuels belonging to or for the use of the United States Government and to the character and value of the fuel in the public lands were begun by the Government in 1904. The method of collecting mine samples, with the various modifications and improvements found desirable through experience, has been continued from that time and is the method followed by those geologists of the United States Geological Survey who have been examining the coal deposits on or near the public lands and by those members of the Survey and the Bureau of Mines who have continued the work of analyzing and testing the coal from the various fields in the United States.

The following statement of the system of mine sampling in use by the Geological Survey and the Bureau of Mines has been revised by Messrs. M. R. Campbell, George H. Ashley, and David White, of the Geological Survey, and Messrs. G. S. Rice and G. S. Pope, of the Bureau of Mines.

NEED OF CARE IN SAMPLING.

In dealing with coals no less than in dealing with ores the taking of samples requires fully as much care as does the making of the analysis or assay, for if the sampling is not properly done and the sample does not fairly represent the coal, then the analysis, however carefully and accurately made, is misleading. It may be impossible or impracticable to obtain another sample from the mine, whereas if an analysis is wrong, another analysis can easily be made of the original sample, as the sample sent to the laboratory is many times the quantity required for the actual laboratory test.

In the field work of the Bureau of Mines, samples are frequently required of special shipments of coal as it is loaded into railroad cars at the mine or as it is unloaded from railroad cars into bins or ships. Printed instructions regarding methods of sampling such shipments are given in Technical Paper 133, entitled "Directions for Sampling Coal for Shipment or Delivery." The underlying principles, as well as the details of methods given in Technical Paper 133, are printed in Bulletin 116, "Methods of Sampling Delivered Coal"; that bulletin

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also treats of the factors that influence the accuracy of sampling; considers the different constituents of coal in their effects on its value; refers to the results of experimental sampling; describes and illustrates the mechanical preparation of samples; describes the specification method for the purchase of coal and gives types of Government coal specifications; and gives specifications and details for the construction of sample containers, riffles, etc.

The purpose of this paper is to describe briefly the method now followed by the Bureau of Mines and the United States Geological Survey in an endeavor to take mine samples that fairly represent the beds of coal that are examined and that show, for the places sampled, the commercial possibilities of these beds. It is of the utmost importance that the sampling be done in a systematic manner, according to a prearranged plan, and that the same procedure always be followed where circumstances permit. Wherever it is possible, unless special samples are desired for a particular purpose, only clean, fresh coal should be sampled, and all dried, weathered, or long-exposed coal should be avoided. When weathered coal, either in the outcrop or in pillars, or other special samples are collected, the particular characteristics of each sample should be clearly described.

RELATION OF MINE SAMPLES TO COMMERCIAL SHIPMENTS.

Experience obtained by the Bureau of Mines during recent years has plainly shown the importance of mine sampling in determining the character of the coal that may be produced by any given mine or district; for example, thousands of mine samples have been taken for the Navy in determining what mines have coal suitable for naval uses. Consistent systematic sampling has shown the value of such procedure. But, on the other hand, the experience thus gained has fully shown that mine samples generally may not represent commercial coal, as regards the ash content and heating value, and that great caution must be exercised in estimating, from the basis of mine samples, the grade of coal shipped, for frequently the ash of the commercial coal may be several per cent higher than the ash found in the mine samples, and the moisture in high-moisture coals "as received" may be several per cent lower. The reasons for this difference are as follows:

1. Care, or lack of care, by miners—who may be naturally careful, indifferent, or careless—in cleaning from the coal sent to the tipple the bone, "sulphur," or "slate" included in the coal bed. The mixing in of pieces of the roof and floor is often the principal source of much of the impurities in the coal shipped, and this is particularly true where the roof is shaly or there is a "draw-slate," or the under clay is so soft that it gets picked up in shoveling loose coal from the floor of the working place.

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2. Degree of discipline and supervision exercised by underground bosses over the miners loading coal.

3. Character of mechanical cleaning apparatus at the tipple and washery.

4. Whether there are enough pickers or trimmers, or washery men, and whether these men are careful or careless in their methods.

5. Whether the coal separates readily from the roof and shale partings, or whether it is "frozen" to them and can not be separated without loosing much of the coal.

In other words, the natural condition of the coal, the labor, the mechanical arrangements, and the supervision may cause so great a variation from the results indicated by the mine sampling, that to consider the mine samples as representing commercial shipments might be misleading. This is particularly true of coal from dirty coal beds containing many partings, or coal beds with a friable roof or a soft bottom.

The mine sample represents the quality that can be obtained when the impurities can be readily separated from the coal, practically perfect mechanical appliances are used, and extreme care is taken by the men in the mine and at the tipple.

Mine samples and delivery samples both must continue to be taken, one as a check on the other. If coal of a particular character is needed, and the mine samples do not disclose that the coal is suitable, it is idle to expect that the commercial coal will be satisfactory. Hence, for large users of coal the mine sampling should be done first and the sampling of delivered coal should follow. The mine operators themselves can benefit by following the two kinds of sampling in order to insure that their product is being so cleaned as to give the best results possible. If the difference between the mine samples and the samples from shipments is too great there is evidently need of changing the method or the appliances. Dirty coal not only means a loss of heat and increase of labor to the consumer, but also a great loss to the country through the transportation of worthless refuse and this loss increases with the distance the coal has to be hauled.

Mine sampling, therefore, is invaluable in studying the possibilities of improving the quality of coal shipments, and of determining the advisability of installing any cleaning or washing machinery and the type of cleaning machinery best adapted to the character of the coal and the impurity to be separated.

COLLECTING OUTFIT OR SAMPLING KIT.

The coal-mine sampling outfit (fig. 1) used by the Bureau of Mines comprises the following articles: Carrying bag, sampling cloth (heavy oilcloth), portable mortar and pestle, spring balance, screen, sampling

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scoop, chalk, brush, measuring tape, sample cans, adhesive tape, pick, and shovel.

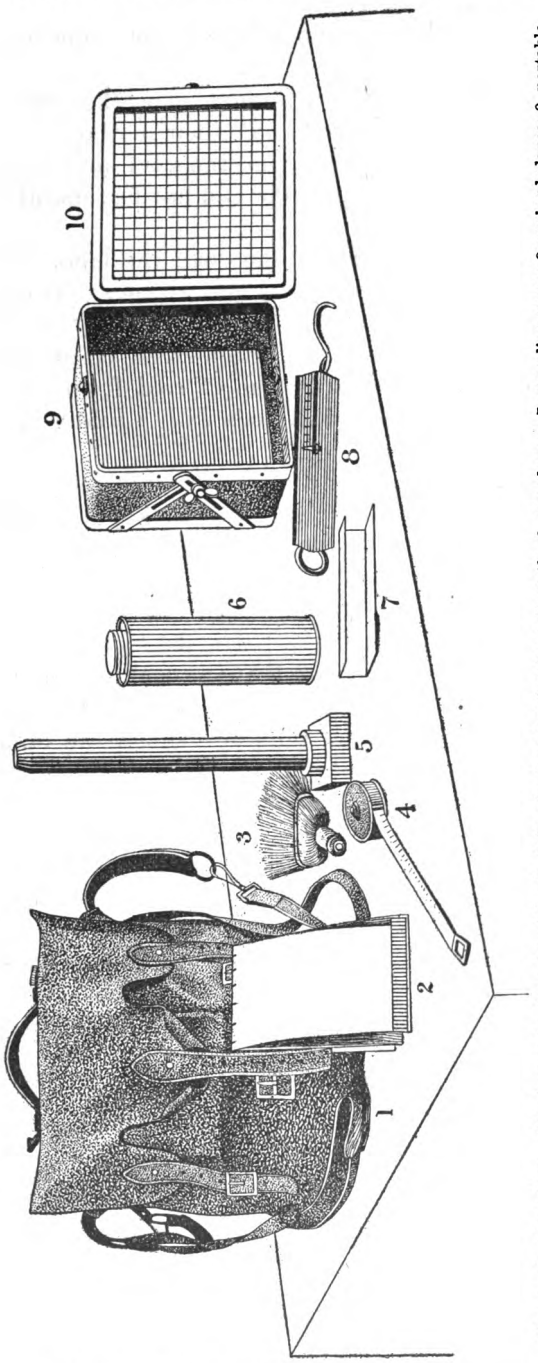

FIGURE 1.—Sampling outfit: 1, carrying bag; 2, notebook; 3, brush; 4, measuring tape; 5, pestle; 6, sample can; 7, sampling scoop; 8, spring balance; 9, portable mortar; 10, screen.

Carrying bag.—The bag used for carrying the sampling outfit and the collected samples is of leather, has a shoulder strap, and measures 13 by 12 by 3 inches.

Sampling cloth.—For collecting the cuttings chipped from the face of the coal a stout sheet or blanket of waterproof material is used. The heavy enamel cloth known as buggy cloth gives good service. The cloth should measure not less than 6 by 7 feet. The enameled side of this cloth should be laid next to the ground to keep out moisture and to prevent fragments of the enamel from getting into the coal sample.

Portable mortar.—A piece of $\frac{3}{4}$-inch board, 10 inches square, covered on the upper side with heavy galvanized sheet iron, forms the bottom of the portable mortar. The collapsible sides are of stout duck, and are fastened at the top to a strap-iron band that is held

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up by collapsible strap-iron posts fastened with set screws. The sides are 5 inches high, making the contents of the mortar about 500 cubic inches.

Pestle.—The pestle for crushing samples consists of a steel head, 1 inch thick and 3 to 4 inches square, with a screw socket to receive a wood handle about 14 inches long.

Spring balance.—A good spring balance of 50-pound capacity, graduated preferably to one-half pound, is used for weighing the samples.

Screen.—The screen is of galvanized-iron wire and has a ½-inch, or preferably ⅜-inch, mesh. It is about 10 inches square and has a wood frame.

Sampling scoop.—The scoop recommended is made of heavy galvanized sheet iron, with flat bottom and vertical sides, and is 8 inches long, 2 inches deep, and 1¼ inches wide. If such a scoop is not available, a bricklayer's trowel or even a wooden shingle will answer the purpose.

Brush.—A stiff brush or whisk broom is useful for brushing off loose pieces of coal, stone, or dirt from the face or roof at the place where the sample is to be taken and for removing the rejected quarterings of coal from the sampling blanket. If such a brush is not available, a piece of cloth or any other suitable material at hand may be used as a substitute.

Measuring tape.—For measuring coal-bed sections a 20-foot waterproof tape graduated to one-fourth inch is used. A steel tape graduated to one-sixteenth inch, though more accurate, is less convenient, as the figures are more difficult to read by the poor light available in mines.

Sample can.—The vessel ordinarily used by the Bureau of Mines and by the Geological Survey for transporting coal samples is a 9 by 3 inch round can of No. 27 galvanized iron. The can filled with coal should not weigh more than 4 pounds, which is the limit of weight for ordinary transmission by mail. The edges of the can are crimped and carefully soldered to make them tight and strong; the screw top (2 inches in diameter) has a gasket or washer of rubber or other flexible material to exclude the air. As a further protection, the outside of the cap, when in place and screwed down tightly, is wrapped carefully with several layers of adhesive tape so that the first layer of this tape completely covers the joint between the lower edge of the cap and the neck of the can. It is not advisable to use solder, paraffin, or sealing wax of any kind. Before being filled each can should be carefully inspected as to tightness and freedom from rust.

Adhesive tape.—For sealing the connection of the cap and sample can, electrician's adhesive tape of the best quality is used.

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Pick and shovel.—Nothing is better than a miner's pick for cutting samples. A miner's shovel should be taken along for cleaning up the floor, etc. Pick and shovel are not regularly included in the kit, as they can be had at any working mine.

The field men of the Geological Survey, because they often work long distances from a base of supplies and travel by horseback, usually carry a simpler outfit than that described above, consisting of a waterproof blanket, a measuring tape, adhesive tape, a screen, a geologist's pick, an improvised shovel, and the necessary number of sample cans. Instead of using a portable mortar and pestle, a man thus equipped must pulverize the coal with his pick, on a board or other hard surface, and instead of a scoop he must use a trowel or shingle. He does not weigh the coal; and instead of using a brush or broom, he removes loose coal, etc., from the face and roof, and cleans the quarterings off the sampling blanket with a piece of cloth or any other suitable means. He will ordinarily use a miner's pick, if found in the mine, instead of his geologist's pick for cutting down the coal.

PRELIMINARY DETAILS.

SELECTING PLACES FOR SAMPLING.

A map of the mine should be obtained from the company's office for use in studying the layout of the mine with a view of selecting the points at which each sample is to be collected. These points should be so selected that the samples will represent the character of the coal available in the mine as a whole, for future as well as for present shipment. Exceptional features, such as "faults," etc., should be avoided unless special studies of the coal at such places are thought desirable. Where possible wet places should be avoided, as samples from such places may not represent the coal as shipped. If wet coal must be collected, the surplus moisture should be drained off the sampling cloth before mixing the sample and the fact should be stated on the card sent to the chemical laboratory.

The collector must necessarily rely on the mine officials for information regarding the extent and direction of the present and future developments of the mine and the situation in the mine of exceptional features, such as "faults," etc., for ordinarily time does not permit him to make an extensive survey and a detailed study of the mine so as to familiarize himself well enough with all conditions, to enable him to select the most advantageous points for sampling. The points selected, however, should be subject to change as the collector's work in the mines progresses if he finds that the sections of the bed at the points selected do not represent the bed or that operations in certain parts of the mine are liable to be suspended or permanently abandoned.

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NUMBER OF SAMPLES TO BE COLLECTED.

More samples should be collected from mines in which the quality of the coal varies greatly than from mines in which the variation is small. Where only a part of a bed is being mined, and the remainder (1 foot or more in thickness) is being left underground, separate samples should be collected at each sampling place of both the worked and the unworked parts or benches of the bed. In sampling coal beds exposed in ordinary prospect openings, where the coal is usually more or less weathered, one sample from each opening is considered enough unless the openings are far apart; in that event, occasional second or check samples are highly desirable. From any mine that is shipping coal not less than three samples should be taken and the number to be taken should increase with increase in the daily output of the mine—not less than three samples for outputs up to a daily average of 300 tons, four samples for average outputs of 300 to 500 tons, five samples for outputs of 500 to 1,000 tons, six samples for an output of 1,000 to 1,500, and an additional sample for every 500 tons daily output over 1,500 tons.

METHOD OF SAMPLING.

CLEANING OFF THE FACE OF THE COAL.

At each selected point, before a sample is cut, the face of the bed should be cleared of burned powder, dirt, or loose coal from roof to floor for a width of about 5 feet. This is done to prevent any loose fragments or foreign matter from falling off the face of the coal onto the sampling cloth. Insecure pieces of the roof should also be taken down in advance for the same reason. In the middle of this cleared area on the face, the coal should be cut away with the pick from the roof to the floor for a width of 1 foot and a depth of at least 1 inch or to a greater depth as may be required with a view to removing any discolored, altered, or otherwise inferior coal that might be near the surface, and also to square up this portion of the face in preparation for the sampling cut.

WHAT TO INCLUDE IN THE SAMPLE.

There should go into the sample as it is cut from the face all the material that ordinarily goes into the daily shipments of coal. There should be omitted from the sample only such material as is ordinarily discarded by the miner. Usually partings more than three-eighths of an inch thick and lenses or concretions of "sulphur" or other impurities more than 2 inches in maximum diameter and one-half of an inch thick are excluded, if in the judgment of the sampler they are being excluded by the miner from the coal as loaded out of the mine or as shipped. If such impurities, or other impurities, are not

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generally excluded by the miner, they should be included in the sample. If pillars are being "pulled," careful note should be made not only of partings but of materials from the roof that are not rejected by the miner. Where the impurity to be rejected, like bone or slaty coal, does not show conspicuously, it is advisable to outline the impurity with chalk in advance so as to prevent its being overlooked when the sample is cut.

Imitating the miner in excluding impurities is the best method, but this requires care and judgment, especially where the partings are soft and friable. No two miners can be relied on to discard the same partings to the same extent, even at mines where the most rigid regulations for cleaning the coal are in force. As it is desired to obtain samples that represent as nearly as possible the coal that is produced commercially from the mine under examination, the method given in the above paragraph should be followed as closely and as uniformly as possible. The carrying out of this method demands the exercise of judgment and experience on the part of the sampler, and he must familiarize himself with the impurities in the coal bed and their relation to the coal which is shipped.

COLLECTING AND PREPARING THE SAMPLE.

The collector should smooth and clean the floor and spread the sampling cloth on it close to the face of the coal. Then he should make a perpendicular cut 2 inches deep and 6 inches wide (or 3 inches deep and 4 inches wide in the softer coals) from the roof to the floor down the middle of the foot-wide cut previously made in the coal face. He should be careful to make this cut uniform in width and depth and should chip off enough coal to make a sample weighing at least 6 pounds for each foot of the thickness of the bed; so that the sample collected on the cloth from a 6-foot bed will weigh not less than 36 pounds. Inexperienced collectors should weigh their samples (by spring balance or otherwise) as a check on the accuracy of their work.

As soon as the cutting of the sample has been completed, if the full outfit previously described is available, the finer portions of the sample should be put through the ½-inch or ⅜-inch screen and the lumps should be broken in the mortar until all the coal passes through the screen. The sample should then be thoroughly mixed by two men grasping the opposite corners of the sampling cloth and rolling it diagonally by raising one corner at a time, and after being thoroughly mixed should be formed into a conical pile by gathering together the four corners of the cloth. Then the cloth should be laid on the floor and the top of the pile flattened with a clean dry shovel, trowel, or board. The sample is then quartered and two opposite quarters are discarded and brushed off. The remainder is mixed as before,

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and if the sample is still too bulky for convenient handling it is again quartered down. The material finally remaining is spread into a circular mass about 2 inches deep on the cloth, and the sampling scoop is used to fill the sample can compactly with portions from opposite quarters. The entire operation described above, from the cutting of the sample to the sealing of the can, should be done in the mine so as not to expose the coal to the outside atmosphere.

THE CAN SHOULD BE COMPLETELY FILLED.

It is important that the coal be well packed in the can, so as to occupy as much of the space as possible, for in that way the air is more nearly excluded. This is best accomplished by shaking or jarring the can repeatedly and vigorously while filling it.

LABELING.

Each sample can when sent out should have a number printed on it. This number is to be used by the collector as the field number for the sample placed in that can for analysis, and is to be recorded in his notebook and on his cards. Before the can is sealed, a folded label should be placed in it on the top of the coal. This label should bear the can number, the name and location of the mine, the name of the collector, and the date. Each can should be wrapped with several thicknesses of heavy manila paper which should be carefully and securely tied. Then the addressed franked wrapper should be pasted on or tied around the wrapped can, the collector filling in the blank spaces on the addressed wrapper with information showing the name of the collector and date of collection.

SEALING THE CAN.

As soon as the can has been filled and the label (described above) placed inside, the cap should be screwed on so that the top of the screw fits tightly into the rubber or other flexible material in the cap; adhesive tape should then be carefully wrapped around the lower outer edge of the cap in such a manner as to cover the joint and increase the thoroughness of the sealing.

NOTES.

To facilitate the gathering and recording of data concerning the samples of coal and the mines from which they are taken, blank forms have been prepared for the use of collectors. These forms can be had upon application to either the Director of the Bureau of Mines or the Director of the Geological Survey. The forms,[a] which are of convenient size for the pocket, indicate what information is desired

[a] Copies of the forms are appended to this circular.

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concerning the nature and operations of the mine, the number, depth, and character of the beds of coal, the specific location from which each sample was taken, and the exact character of the bed at the point of sampling, and make specific mention of bands of "sulphur" (pyrite, etc.), shale, or other objectionable material that should be excluded in shipment.

The record of the coal-sample section should be made in the mine from actual measurements, immediately after the collection of the sample and the sealing of the sample can.

PROMPT FORWARDING AND ANALYSIS OF SAMPLES.

The cans containing the samples should be delivered by the collector in person to the nearest post office for forwarding by the first mail to the laboratory.

It is expected that each sample on its receipt at the laboratory will be placed in a dark, cool place, and that the analysis will be completed within two weeks.

SENDING NOTIFICATION CARDS.

The cards, supplied in advance to each collector, are in two forms, A and B. After entering certain data called for in the forms the collector forwards, in sealed envelope, one card A for the mine and a card B for each sample, to the Bureau of Mines chemical laboratory. As soon as these cards and the corresponding sample are received at the laboratory a statement of the receipt of sample is then sent to the chief of the field party, in order to give notice of the arrival of the sample. Copies of these cards are shown on pages 15 and 16.

Special attention should be given to filling out and promptly forwarding these cards. Failure to fill out a card properly or to forward it promptly may cause indefinite delay in making the analysis of a sample.

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U. S. BUREAU OF MINES.

A.—*Description of mine.*

(1) State..... (2) County..... (3) Town.....
(Post office.)

(4) Mine sample of.....
(Material—for coal, give classification.)

(5) Coal field..... (6) District.....

(7) Mine.....
(a) Name. (b) Kind of opening—if shaft, give depth. (c) Height of, above sea level.

(d) Distance and direction from town. (e) Sec., T., and R., if necessary. (f) Railroad connections.

(g) Shipping point. (h) State if wagon mine or prospect; and give distance from shipping point.

(8) Coal bed.....
(a) Name. (b) Geologic system. (c) Formation. (d) Dip, degrees. (e) Strike, direction.

(9) Mining system..... (10) Undercutting.....
(Long wall, room and pillar, panels, etc.) (Hand or machine.)

(11) Explosives.....
(a) Used for coal. (b) Used for roof or floor.

(12) Operator..... (13) Sales agent.....
(Name and address.) (Name and address.)

(14) Output per day..... (15) Max. day's output.....
(Average—gross or net tons.) (During last year.)

(16) Last year's output..... (17) Output from advance workings, per cent.....
(At present.)

(18) Acres of coal unmined..... (19) Lifetime of mine.....
(Years—estimated.)

(20) Run of mine, per cent..... (21) Is coal screened?.....
(Of output shipped.)

(22) Type and size of screens..... (23) Type of washer.....

(24) Per cent of coal washed..... (25) Max. size washed.....

(26) Sizes produced..... (27) Sizes produced.....
(Washed coal.) (Of coal not washed.)

(28) Is coal picked?..... (29) Number of pickers.....
(State whether on belt or car.)

(30) Per cent of coal coked..... (31) Sizes coked.....
(At mine.) (Screenings, crushed, washed, etc.)

(32) Type and No. of ovens.....

(33) Remarks.....
(Indicate after subject by mark (x) if additional information is given here.)

.....
(If this space is not sufficient, use back of card, making reference thereto.)

(34) Can Nos.....: .....: .....: .....: .....: .....: .....: .....: .....
(Give Nos. of all samples forwarded.)

(35) Lab. Nos.....: .....: .....: .....: .....: .....: .....: .....: .....
(Laboratory to fill in numbers immediately below corresponding can numbers.)

(36) Mine sampled at..... points, by .....on ..... 19...
(Number.) (Collector.) (Office.) (Date.)

NOTE.—Fill in only one copy of this form for a mine. Mail to laboratory with B cards. Put remarks, if any, on back.

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..... (Can No.)

U. S. BUREAU OF MINES.

B.—*Sampling report.*

..... (Lab. No. Lab. fill in.)

(1) State..... (2) County..... (3) Town..... (Post office.) (4) Mine..... (5) Operator.....

(6) Sample of..... (Material—bituminous, etc.) (7) Analysis desired..... (8) Method of sampling..... (Describe if other than standard.)

(9) Location in mine ..... (Distance and direction from opening; locate with respect to rib, room, pillar, air course, entry, etc.) (10) Date ..... (Of sampling.) 19...

(11) Coal dry or moist..... (12) Gross wt., lbs..... (Sample cut.) (13) Net wt., lbs..... (Sample mailed.) (14) Sample from fresh or weathered coal .....

(15) Roof..... (Kind and quality.) (16) Draw slate or roof coal..... (Description and thickness.)

(17) Floor..... (Kind, soft or hard, smooth or rough.) (18) Vertical depth from surface to point of sampling—feet.....

No.	Section of bed.	Feet.	Inches.	No.	Section of bed.	Feet.	Inches.	No.	Section of bed.	Feet.	Inches.
1	.....	.....	.....	7	.....	.....	.....	13	.....	.....	.....
2	.....	.....	.....	8	.....	.....	.....	14	.....	.....	.....
3	.....	.....	.....	9	.....	.....	.....	15	.....	.....	.....
4	.....	.....	.....	10	.....	.....	.....	16	.....	.....	.....
5	.....	.....	.....	11	.....	.....	.....	.....	Total thickness of bed....	.....	.....
6	.....	.....	.....	12	.....	.....	.....	.....	Thickness in sample.....	.....	.....

(19) Excluded from sample, section Nos.....

(20) Send analysis to..... (21) Collector..... (22) Office.....

NOTE.—Exclude from sample all partings that are rejected in mine or at tipple, and make record (×) in above table.
This card to be mailed to laboratory with A card.

NOTE.—Fill in information and detach at line of perforations. Fold this section and place in can on top of coal.

Can No..... State..... County..... Town.....

Mine..... Date..... 19... Collector..... Office.....

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BLANK FORMS FOR COLLECTORS.

Copies of some of the blank forms carried by the engineers of the Bureau of Mines for recording the information desired regarding a sample of coal and the mine from which it is taken are given herewith. These forms are printed on separate sheets that are perforated, and are intended for use with a loose-leaf binder. They make a notebook measuring about 4½ by 7½ inches. (See following pages, forms B, C, D, and E being omitted as not relating to character of coal.)

DEPARTMENT OF THE INTERIOR.

BUREAU OF MINES.

A.—*Physical features of the mine.*

Name of collector.....
Mine ..... Date.....
State..... County.....
Township..... S..... T..... R.....
Mine location (distance and direction from nearest railway station).....
Mine railway connections.....
Operator of mine.....
Address of operator.....
Address of mine.....
Superintendent.....
Pit boss.....
Selling agent.....
Address.....
Trade name of coal.....
Coal-bed name..... Geologic formation.....
Kind of coal.....
Average thickness of coal bed.....feet.....inches.
Dip of bed.....° Direction of dip.....
Has coal "faces"?..... Direction of.....
Faults.....; frequent?.....
Rolls or horse backs.....; frequent?.....
Does mine make methane?.....from coal, roof, or floor.....
Quantity evolved.....maximum in return.....per cent.
Entrance to mine: Drift, cross-drift, slope, shaft.....
Elevation of entrance above sea, barometric reading..... Actual.....feet.
Vertical depth to bed (below entrance).....feet.
System of mining.....
Is mine laid out with reference to "butts" and "faces"?.....
Entry width, main.....feet; side entry.....feet; stub.....feet.
Pillar width, main.....feet; side entry.....feet; stub.....feet.
Room pillar width.....feet; barrier pillar width.....feet.
Room width.....feet; room length.....feet.
Room pillars pulled?..... Entry pillars pulled?.....
Proportion of coal taken in advance work.....
Per cent recovery excluding roof coal.....per cent including.....per cent.

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F.—*Mining conditions.*

Range in thickness of coal as mined: From .....feet.....inches.
to.....feet.....inches. Average .....feet.....inches.
Variability of partings or other impurity in character and thickness?.....
.....
Roof (*a*) "Draw slate" (coming down with coal).....thickness.
(*b*) Shale, quality, color, etc.....
.....
(*c*) Roof coal..... Quality..... Thickness.....
(*d*) Sandstone or limestone.....
Is immediate roof smooth or does coal stick?.....
Does immediate roof fall in rooms?.....
Is there a cap rock or main roof above?.....
Height of cap rock, etc., above coal.....feet.
Do particles of roof get mixed with coal in loading?.....
Vertical height to nearest workable coal above.....feet.
Vertical depth to nearest workable coal below.....feet.
Floor or underclay:
Kind.....
Softness.....
Smooth or rough.....
Do particles get mixed with coal?.....
Is coal undercut in clay floor or in coal?.....
Undercut by hand or machine?.....
Are machine cuttings loaded with coal?.....

FUTURE OUTPUT AND PRODUCTION.

Approximately what unmined area is to be taken out from present opening?....acres.
What is probable lifetime of mine?.....years.
Is the tonnage to be derived from advance work or pillars.....
In what proportions?.....
Present average daily output of mine.....tons (2,000 pounds).
Maximum day's run.....
To what extent is daily output to be increased or diminished in future?.....
.....

G.—*Preparation for market.*

Proportion of output shipped as "run of mine".....
What percentage of coal going to screens passes through?.....
.....
Type of lump screens, bar, shaking, etc.:
Size of opening.....
(*a*) Bar, length.....feet.
Spaces, width.....inches.
(*b*) Shaking screen, area.....feet by.....feet.
Diameter of holes.....inch.
Type of small-coal screens, if any:
(*a*) Bars, length.....
Space, width.....inches.
(*b*) Shaking screens, area.....feet by.....feet.
Diameter of holes.....inch.
(*c*) Revolving screens, length.....feet.
Diameter of holes.....inch.
Diameter of mesh.....inch.

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Is coal picked on belt or on car?.....
Numbers of pickers (or trimmers who pick).....
Are screenings washed?..... Maximum size washed.....inch.
Sizes produced by washing.....
Type of washery.....
Average daily tonnage.....tons (2,000 pounds).
Are screenings coked?..... Are they crushed?.....
Average daily tonnage coal coked.....
What storage-bin capacity?.....tons.
Appearance of lump coal on cars.....
Lumps, large or small?.....
Appearance of screenings on cars.....
Loading tracks, number of.....
Track capacity for empty railway cars.....
Track capacity for loaded railway cars.....
REMARKS:
.....
.....
.....

H.—*Coal sample section.*

Mine..... Date,....., 191...
State..... Can No.....
County..... Township.....
Name of bed of coal.....
Location of mine.....
Total (vertical) depth from surface at point of sampling.....feet.

[In describing the beds and character of the members note any member that is rejected by the miner. Note all clay and "sulphur" partings, whatever their thickness. Exclude from sample all clay and "sulphur" partings ½ inch thick or over (and even those of less thickness) if they are rejected at mine or tipple.]

Section of bed at point sampled.

Description.	Feet.	Inches.
Roof (main).....		
Roof (immediate).....		
No. 1.....		
2.....		
3.....		
4.....		
5.....		
6.....		
7.....		
8.....		
9.....		
10.....		
11.....		
12.....		
13.....		
14.....		
Total.....		
Floor.....		

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Is coal sample wet or dry?.....
Time exposed.....hours.....minutes.
Weight.....gross.....net.
What are the impurities and how do they occur?.....
.....
What impurities are shipped with the coal?.....
What impurities are excluded from the sample?.....
Collector.....

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PUBLICATIONS ON THE SAMPLING AND ANALYSIS OF COAL.

A limited supply of the following publications of the Bureau of Mines has been printed and is available for free distribution until the edition is exhausted. Requests for all publications can not be granted, and to insure equitable distribution applicants are requested to limit their selection to publications that may be of especial interest to them. Requests for publications should be addressed to the Director, Bureau of Mines.

The Bureau of Mines issues a list showing all its publications available for free distribution as well as those obtainable only from the Superintendent of Documents, Government Printing Office, on payment of the price of printing. Interested persons should apply to the Director, Bureau of Mines, for a copy of the latest list.

PUBLICATIONS AVAILABLE FOR FREE DISTRIBUTION.

BULLETIN 28. Experimental work conducted in the chemical laboratory of the United States fuel-testing plant at St. Louis, Mo., January 1, 1905, to July 31, 1906, by N. W. Lord. 51 pp.

BULLETIN 85. Analysis of mine and car samples of coal collected in the fiscal years 1911 to 1913, by A. C. Fieldner, H. I. Smith, A. H. Fay, and Samuel Sanford. 1914. 444 pp., 2 figs.

BULLETIN 119. Analyses of coals purchased by the Government during the fiscal years 1908–1915, by G. S. Pope. 1916. 118 pp.

BULLETIN 123. Analyses of mine and car samples of coal collected in the fiscal year 1913 to 1916, by A. C. Fieldner, H. I. Smith, J. W. Paul, and S. Sanford. 1918. 478 pp., 2 figs.

TECHNICAL PAPER 8. Methods of analyzing coal and coke, by F. M. Stanton and A. C. Fieldner, 1913. 42 pp., 12 figs.

TECHNICAL PAPER 64. The determination of nitrogen in coal, a comparison of various modifications of the Kjeldahl method with the Dumas method, by A. C. Fieldner and C. A. Taylor. 1915. 25 pp., 5 figs.

TECHNICAL PAPER 76. Notes on the sampling and analysis of coal, by A. C. Fieldner. 1914. 59 pp., 6 figs.

TECHNICAL PAPER 133. Directions for sampling coal for shipment or delivery, by G. S. Pope. 1917. 15 pp., 1 pl.

TECHNICAL PAPER 148. The determination of moisture in coke, by A. C. Fieldner and W. A. Selvig. 1917. 13 pp.

TECHNICAL PAPER 172. Effects of moisture on the spontaneous heating of stored coal, by S. H. Katz and H. C. Porter. 1917. 25 pp., 1 pl., 8 figs.

PUBLICATIONS THAT MAY BE OBTAINED ONLY THROUGH THE SUPERINTENDENT OF DOCUMENTS.

BULLETIN 11. The purchase of coal by the Government under specifications, with analyses of coal delivered for the fiscal year 1908–9, by G. S. Pope, 80 pp. 10 cents.

BULLETIN 22. Analyses of coals in the United States, with descriptions of mine and field samples collected between July 1, 1904, and June 30, 1910, by N. W. Lord, with chapters by J. A. Holmes, F. M. Stanton, A. C. Fieldner, and Samuel Sanford. 1912. Part I, Analyses, pp. 1–321; Part II, Descriptions of samples, pp. 321–1129. 85 cents.

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BULLETIN 41. Government coal purchases under specifications, with analyses for the fiscal year 1909–10, by G. S. Pope, with a chapter on the fuel-inspection laboratory of the Bureau of Mines, by J. D. Davis. 1912. 97 pp., 3 pls., 9 figs. 15 cents.

BULLETIN 63. Sampling coal deliveries and types of Government specifications for the purchase of coal, by G. S. Pope. 1913. 68 pp., 4 pls., 3 figs. 10 cents.

BULLETIN 116. Methods of sampling delivered coal, and specifications for the purchase of coal for the Government, by G. S. Pope. 1916. 64 pp., 5 pls., 2 figs. 15 cents.

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